The Effects of a Web-Supported and Well-Structured Problem-Based Method on Achievements of Learners

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Abstract

Teaching computer programming (CP) has been one of the most researched topics in educational computing. Many methods, tools and environments have been proposed to enhance understanding of a programming language or paradigm. However, learning CP remains difficult. Problem-based learning (PBL) is another topic attracting many researchers. While problem solving (PS) ability of an individual plays an important role for adapting herself to the environment, it has also showed that it can contribute to improving cognitive skills required in other learning contexts. For example, PS and CP have much in common. In essence, CP is a type of problem solving process. Although studies indicate expert computer programmers can consciously employ PS strategies, low-performing programming students generally lack PS skills. There are two important points in this issue. The first; CP learners have to generalize their programming skills in the form of well-defined patterns long before they attempt to produce professional solutions. Thus, the integration of PS and CP skills requires an instructional approach guided by a theory. The second; students need to extend their information-searching ability, which is essential for high-level problem-solving performances. To that aim, students have also to learn interacting with computers for its potential to enhance PS ability. Therefore, the purpose of our study was to explore the effects of a web supported and well-structured problem-based instruction on achievements of CP learners. The 433 freshman undergraduate students, who attended the “Introduction to Computer Programming with C” course, participated in the study. They were 2.3% female (n=10) and 97.7% male (n=423) aging from 18 to 20. The participants were grouped into 18 sections, and randomly assigned to either of the experimental groups: (1st group) the web supported and problem based; (2nd group) the web supported only. The group-1 was administered as the treatment. The fundamentals of C programming were given during the course, and it consisted of a two-hour lecture and a one-hour lab per week, with 15 weeks per semester. The course’s contents were presented during lecture hours, and the lab hours were for practicing. However, the instructional designs differed for both of the experimental groups. Jonassen’s [1] well-structured problem-based model was adopted for the group-1‘s instructional design. The first three steps of problem-based model were during the lecture hours while the next three steps were in the lab hours. The web-based tool presented the related parts of the problem-based activities as well as supported the group-1’s classroom environment. However, the group-2’s instructional design was similar to a traditional classroom-programming course with the exception that the web-based tool provided the functionalities for posting only the course’s materials. Since, the academic achievement tests were not normally distributed, the Mann-Whitney test was used for the statistical analysis. As a result, we found a statistically significant difference between the groups according to the academic achievements ($z = -3{,}211$; $p < {,}05$). It is possible to state that the learners instructed with the web-supported problem-based method displayed higher academic performances. We also observed that the web-supported environment provided an effective and efficient mechanism for the design and implementation of a problem-based instruction.

References

[1] Jonassen, D.H. (1997). Instructional design models for well-structured and ill-structured problem-solving learning outcomes. *Educational Technology Reseach & Development*, Vol-45, No-1, pp. 65-94.